Paper ID: 51644
oral

IAF EARTH OBSERVATION SYMPOSIUM (B1)
Earth Observation Data Management Systems (4)

Author: Mr. Victor Loke
National University of Singapore, Singapore, Republic of, tslvl@nus.edu.sg

Ms. Dan Feng
National University of Singapore, Singapore, Republic of, tslfeng@nus.edu.sg
Mr. Wen Yong, Benedict Chong
National University of Singapore, Singapore, Republic of, a0110679@u.nus.edu
Prof. Cher-Hiang Goh
National University of Singapore, Singapore, Republic of, elegch@nus.edu.sg
Mr. Chin Yang Koay
National University of Singapore, Singapore, Republic of, e0154174@u.nus.edu

CLOUD-BASED GROUND SEGMENT ARCHITECTURE FOR DATA-INTENSIVE SPACE MISSIONS

Abstract

Web applications are experiencing an explosive growth in popularity as the choice platform for software development. Aside from the benefits of native remote access and mobility, many web development frameworks today offer commercial-grade and a huge pool of community-curated library extensions. Most importantly, industries across the board are experiencing a paradigm shift towards an open-source ecosystem by extending developer APIs to platform partners.

Space missions are no exception. The steep investments and stakes associated with modern space programmes are matched only by their expected ROI. In particular, phenomenal attention is being given to data because of the valuable insights that could be derived from its possession. Space analysts are predicting that space data analytics will take the world by storm in the coming decade, with demand led by satellite-enabled IoT and communications networks amongst other applications.

We first introduced our mission planning software developed using progressive web technology at the 11th IAA Symposium on Small Satellites for Earth Observation. Since then, the application has matured into a full-fledged mission operations software complete with a terminal node controller interface based on the CubeSat Space Protocol for the 2U Galassia nanosatellite.

At the 70th International Astronautical Congress, we present our ground segment data stack, **SpaceSeer**, which is architected to support future data-intensive space missions. Downlinked data across geographically dispersed TNC terminals are simultaneously fed into the batch and speed layers of SpaceSeer's lambda architecture stack. The batch layer, implemented using Apache Hadoop, precomputes results in a distributed fashion and is capable of handling very large quantities of data. The speed layer processes each data stream on-the-fly and focuses on providing real-time views while sacrificing completeness. Both the batch and speed layers feed into the serving layer for consumption. Such an architecture is able to service the needs of both the mission operator, who require access to hot data for real-time visibility on operational status of the constellation, as well as space data analysts who requires colder data for downstream processing.

The entire application is containerized using Docker and deployed on AWS cloud. Horizontal scaling may be achieved by ramping the application across multiple hosts comprising hundreds of containers; we use Kubernetes, a popular orchestration tool, to manage these instances in a distributed manner. Finally, we conclude by discussing the integration of SpaceSeer with Galassia-2, a 3U nanosatellite comprising an optical imaging and high data-rate communications payload with launch planned in 2021.